1st International Conference on Current Research in Engineering (SIEICON-2017)
April 13, 2017
Sigma Institute of Engineering, Ajwa-Nimeta Road, Vadodara, Gujarat, India

Automatic Rescue Device for Elevator

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Abstract-*The paper reveals about an emergency system which is installed in the elevator mainly to rescue people during sudden power failure from the main supply. This paper also reveals about the replacing the batteries by the electrolytic capacitors as a main source. The Alternative Rescue Device (ARD) consists of an Uninterruptable rescue device (UPS) system which contains capacitor bank as a source.*

Keywords*- Rescue device, Electrolytic capacitor, Elevator, ARDUINO, Automatic shifting, Proteus.*

I. INTRODUCTION

The alternative rescue device is an emergency system installed in the elevators to supply power whenever there is a power failure to rescue people from the elevators without any casualties. In present ARD, about 12 batteries of 12V each in series-parallel connection are used as a source for the UPS system.

Some of the drawbacks of using battery as a source in this system are as follows:-

(i) Provision has to be made after battery has fully charged or else the life of the battery reduces. At the same time care has to be taken that the battery after been completely discharged, has to kept for charging so that it comes in action at the time of need.

(ii) Charging time of the battery is very long, i.e. once it gets discharged, the system gets useless until the battery is again charged.

(iii) They are expensive.

Therefore, Electrolytic Capacitors has been used in this paper as a source just to show that they can replace battery in some of the application where for limited period power supply is needed. Its advantages against the battery are as follows:-

(i) Electrolytic capacitors doesn't need any provision after they are fully charged because they itself stops drawing current whenever they are charged.

(ii) Charging time of capacitors is very less as compared to the charging time of the battery.

(iii) Cost of electrolytic capacitors is much less than the cost of battery for the same ratings. Also the maintenance cost of the capacitors is minimum.

II. LITERATURE REVIEW

James C. IIall, J.Werner Remartz [1] The present invention continually monitors the main power provided to an elevator system. This power passes through a series of contacts in the system. Upon sensing a power loss or irregularity, a power loss sensing device will disconnect the elevator system from the main power system (i.e., line). The device will provide a signal to an inverter timing system indicating that the elevator system is on emergency power. Then, a back-up system provides a parallel power feed to the elevator system. This power Will be used to recover functioning of the elevator controller, the elevator door control system, and the traction motor drive system. As the elevator controller contains several control transformers, the back-up system is capable of supplying the first few electrical cycles (e.g., 50 milliseconds) of inrush current. In addition, as the VFD is a bridge rectifier system feeding a large amount of capacitance, the back-up system is able to provide the initial charging of the dc bus capacitors. Once the elevator electrical system has been recharged and

Stabilized, the elevator controller Will provide an appropriate speed and direction command to the traction motor drive system.

Hiroshi Araki [2] describes that when the three-phase commercial power source is in the state of a power failure, the operation of the elevator becomes possible through the power source supply from the power accumulator. In general, the secondary battery is used in the form in Which sets of batteries each having about ten or less plural cells connected in series With one another are further connected in series With one another. However, if, for example, the number of series combinations of the secondary battery is selected so as to have the charge/discharge capability With Which about one half the rated output of a motor depending on the speed and the load capacity of an elevator, then all of the regenerative powers can be charged since the regenerative power is about one half the rated electric power, and hence the maximum effect can be expected for the energy saving. In addition, at the time of a power failure, period of time (distance) during which the operation is possible is determined on the basis of a quantity WH of power accumulated in the power accumulator. Conversely, if from the SOC in the normal running before a power failure to the SOC from start to finish of the discharge (here, the SOC from start to finish of the discharge means the SOC in Which the discharge is possible in the range of not degrading batteries, and hence if the power is supplied in order to operate an elevator, then the terminal voltage of the secondary battery is abruptly decreased so that the desired power cannot be supplied in some cases)

III. BLOCK DIAGRAM OF AUTOMATIC RESCUE DEVICE FOR ELEVATOR

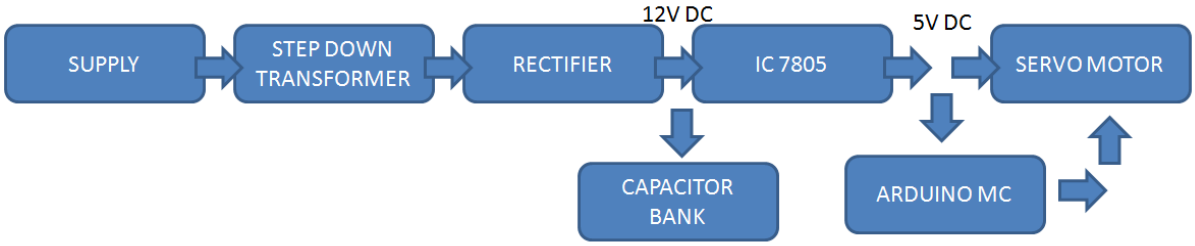


Figure: 1 Block diagram of automatic rescue device for elevator

The supply is an AC single phase. Having 230voltage input 50 Hz is supplied to the transformer which is an step down transformer it transform 230V AC to 12V AC. This 12V AC is then transmitted to rectifier for conversion of AC to DC supply which converts 12V AC to 12V DC. This 12V DC is then transmitted to 12V DC terminal which is used for further connections where ever the 12V DC is required. That 12V DC is then transmitted to IC7805 which is used to convert 12V DC to 5V DC. The 12V DC is transmitted to the capacitor bank where the power is been stored till the capacitor is been fully charged. Capacitor has an property that after fully charging of capacitor the current cannot draws from capacitor that is the main advantage of capacitor due to which its maintenance cost is reduced. The IC 7805 is which gives 5V DC is been supplied to DC Motor and as well as to the ARDUINO UNO R3 which is an microcontroller used in automatic rescue device for elevator. The ARDUINO output is been given to the DC Motor. The ARDUINO is used to control the speed of the DC Motor by controlling the input voltage.

A. Simulation of Automatic Rescue Device

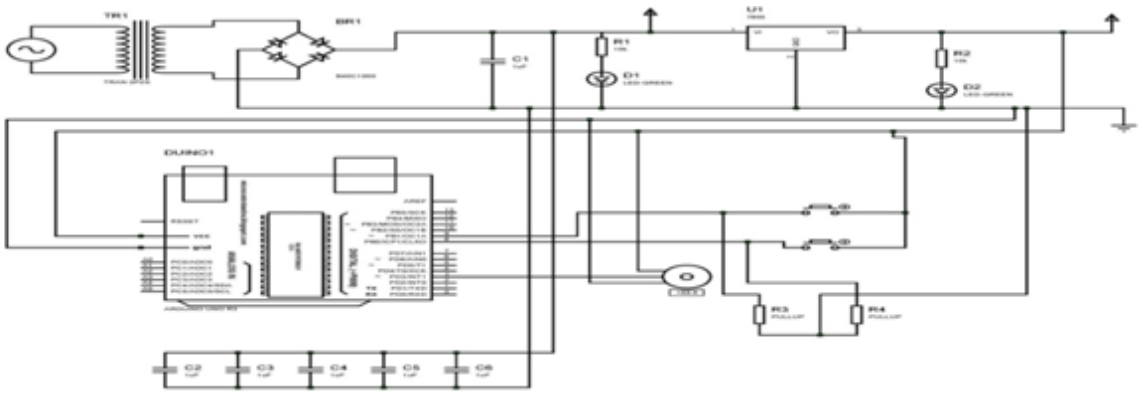


Figure 2: Simulation of ARD for Elevator

The above figure is the simulation of ARD in Proteus software it clearly shown the connection of power supply circuit, controlling circuit, DC Motor, Capacitor bank, switches. The D1 is the green color LED which indicates

the power supply is from main supply if it is off then it is said that main power supply is off and the supply is from capacitor bank. The R1 are connected for the LED purpose. The D2 which indicates that the IC 7805 is 'ON' or 'OFF'. There are two switches which are used to move elevator from on floor to another floor to another. The C2, C3, C4, C5, C6 are the 1 micro faraday capacitor used to build capacitor bank

IV. COMPONENTS USED

A. ARDUINO UNO R3: The ARDUINO UNO R3 is a micro controller board based on the ATmega328 (data sheet).

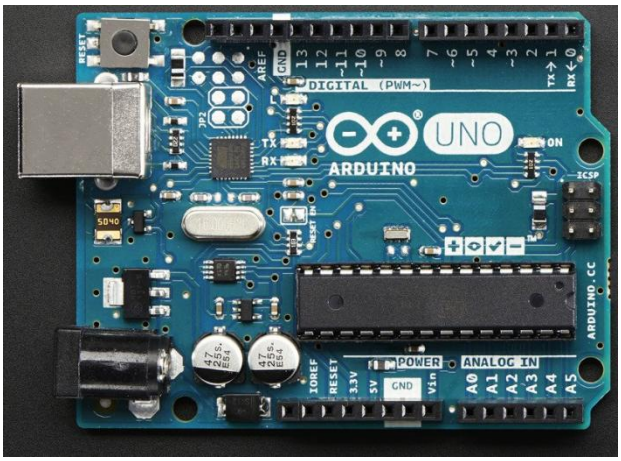


Figure 3: ARDUINO UNO R3

It has 14 digital input/output pins (of which 6 can be used as PWM output), and also has 6 analog input. It contain everything needed to support the microcontroller, simply connect it to a computer or battery to get started. It is cheaper, very easy to setup and toughest board. ATmega328p: It is the brain of the Arduino and it is a high performance Atmel Pico power 8bit AVR RISC based microcontroller which is cable of executing powerful instruction in single clock cycle. ATmega16U2: This microcontroller takes care of the USB connection and ICSP boot loader .The Arduino UNO has 14 Digital pins(6 PWM) and6 Analog pins. Digital pins: Pin 0 to Pin 13. In which pin 0 and pin 1 are used to receive and transmit serial data. PWM: 3, 5, 6, 9, 10, 11. These 6 pins can be used as PWM (Pulse Width Modulation) pins. Using these pins you can control the voltage in turn you can control the brightness of led, speed of the motor or whatever you wish to by varying the voltage. Analog pins: Pin A0 to Pin A5.The main function of Analog pins is reading the values from Analog sensors. The Arduino UNO has super convenient power management and built-in voltage regulation. Unlike older boards the power source is selected automatically. You can directly power it through USB or external power supply. The external power supply can be given by (1).Connecting power source(7-12V DC) to DC power jack (or) (2).Connecting a battery lead to Vin and Gnd. Don't try to power it through 5V or 3.3V pins it will damage the on board regulator. 5V and 3.3V pins can be used to provide power to sensors and modules when connecting it to. Arduino IOREF: This pin provides voltage reference with which the microcontroller operates.

ATmega328p has 32KB of flash memory to store your program and 2KB of SRAM and1KB of EEPROM. It has 16MHz clock on board makes it fast and speediest micro controller. It has a reset button to reset the program on chip. A Led on board is mapped to pin 13 for debugging and testing purpose. A power Led to indicate power. Two Led for RX and TX which blinks when the serial communication takes place.

B. IC LM7805: Voltage sources in a circuit may have fluctuations resulting in not giving fixed voltage outputs. Voltage regulator IC maintains the output voltage at a constant value. 7805, a voltage regulator integrated circuit (IC) is a member of 78xx series of fixed linear voltage regulator ICs used to maintain such fluctuations. The xx in 78xx indicates the fixed output voltage it provides. IC 7805 provides +5 volts regulated power supply with provisions to add heat sink as well.

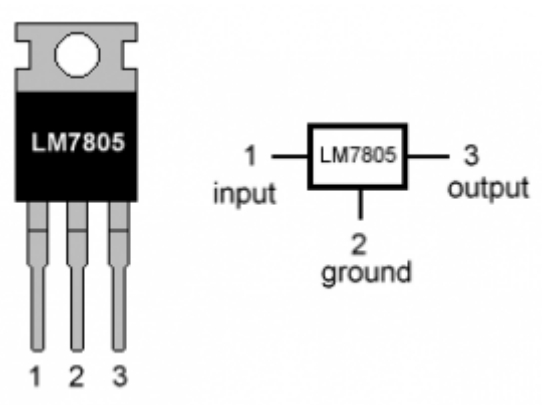


Figure 4: LM7805 pin out diagram

PIN NO	PIN	Function	DESCRIPTION
1	INPUT	Input voltage (7V-35V)	In this pin of the IC positive unregulated voltage is given in regulation.
2	GROUND	Ground (0V)	In this pin where the ground is given. This pin is neutral for equally the input and output.
3	OUTPUT	Regulated output; 5V (4.8V-5.2V)	The output of the regulated 5V volt is taken out at this pin of the IC regulator.

Table 1: Pin detail of IC 7805

The difference between the input and output voltage appears as heat. The greater the difference between the input and output voltage, the more heat is generated. If too much heat is generated, through high input voltage, the regulator can overheat. If the regulator does not have a heat sink to dissipate this heat, it can be destroyed and malfunction.

Heat is an area of concern

7805 is not very efficient and has drop out voltage problems. A lot of energy is wasted in the form of heat. If you are going to be using a heat sink, you better calculate the heat sink size properly. The below formula should help in determining appropriate heat sink size for such applications.

Heat generated = (input voltage – 5) x output current

If we have a system with input 15 volts and output current required is .5 amperes, we have: (15 – 5) x 0.5 = 10×0.5 =5W;

5W energy is being wasted as heat, hence a decent sized heat sink plate is required to disperse this heat. On the other hand, energy actually being used is:

(5 x 0.5Amp) = 2.5W.

So twice the energy, that is actually utilized is wasted. On the other hand, if 9V is given as input at the same amount of load:

(9-5) x 0.5 = 2W

2W energy will be wasted as heat. Higher the input voltage, less efficient your 7805 will be. An estimated efficient input voltage would be over 7.5V.

C. Magnetic Sensor (Reed switch)

Reed switches actuated by magnets are commonly used in mechanical systems as proximity sensors. Examples are door and window sensors in burglar alarm systems and tamper proofing methods (however they can be disabled by a strong, external magnetic field). Reed switches are used in modern laptops to put the laptop on sleep/hibernation mode when the lid is closed. Speed sensors on bicycle wheels and car gears use a reed switch to actuate briefly each time a magnet on the wheel passes the sensor. Reed switches were formerly used in the keyboards for computer terminals, where each key had a magnet and a reed switch actuated by depressing the key; cheaper switches are now used. Electric and electronic pedal keyboards used by pipe organ and Hammond

organ players often use reed switches, where the glass enclosure of the contacts protects them from dirt, dust, and other particles. Here the magnetic sensors are used to check the position of the elevator and to stop the elevators when it has reached the floor.

Figure 5: magnetic sensor

D. Capacitor Bank

Capacitors are electrical/electronic components which store electrical energy. Capacitors consist of two conductors that are separated by an insulating material or dielectric. When an electrical current is passed through the conductor pair, a static electric field develops in the dielectric which represents the stored energy. Unlike batteries, this stored energy is not maintained indefinitely, as the dielectric allows for a certain amount of current leakage which results in the gradual dissipation of the stored energy. A capacitor bank is a grouping of several identical capacitors inter-connected in parallel or in series with one another.

E. The Diode Bridge Rectifier

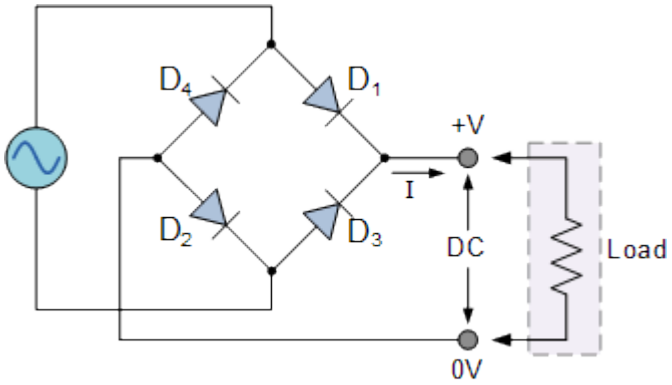


Figure 6: circuit diagram of diode bridge rectifier

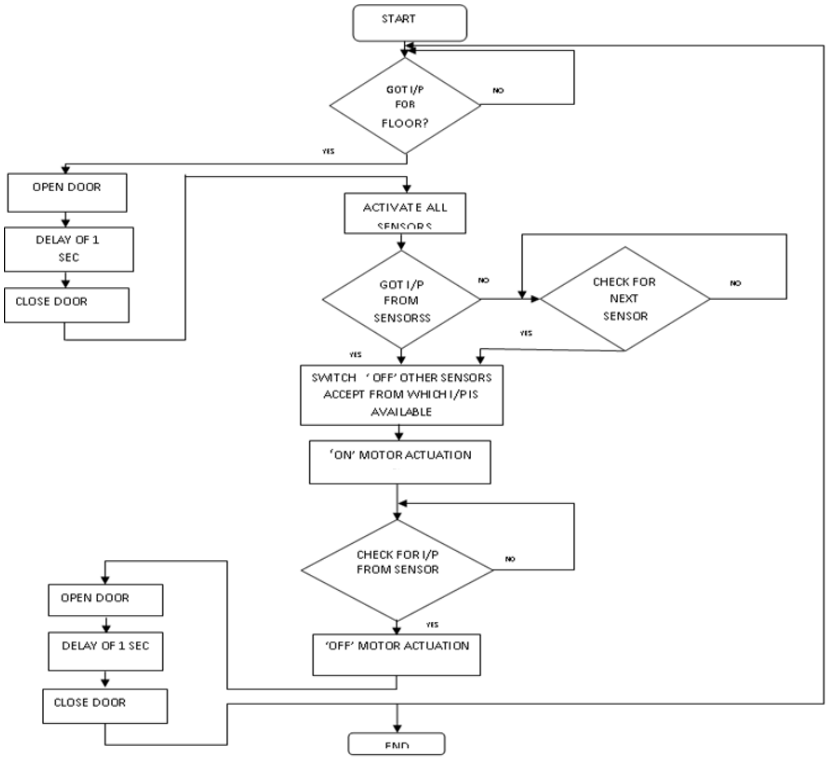
The four diodes labelled D_1 to D_4 are arranged in "series pairs" with only two diodes conducting current during each half cycle. During the positive half cycle of the supply, diodes D1 and D2 conduct in series while diodes D3 and D4 are reverse biased and the current flows through the load as shown below.

Advantage of bridge rectifier

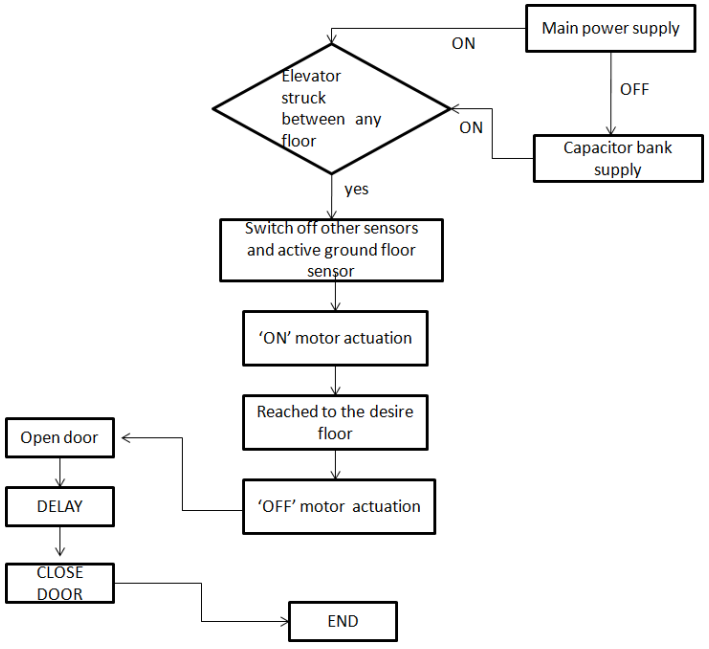
- The rectification efficiency of full-wave rectifier is double of that of a half-wave rectifier.
- Higher output voltage, higher output power and higher Transformer Utilization Factor in case of full-wave rectifier.
- The ripple voltage is low and of higher frequency in case of full-wave rectifier so simple filtering circuit is required
- No center tap is required in the transformer secondary so in case of a bridge rectifier the transformer required is simpler. If stepping up or stepping down of voltage is not required, transformer can be eliminated even.
- For a given power output, power transformer of smaller size can be used in case of the bridge rectifier because current in both primary and secondary windings of the supply transformer flow for the entire ac cycle

V. FLOW CHART

A. Flow chart of elevator during normal running through main power supply



B. Flow chart of elevator during failure of main power supply



VI. WORKING

When a single phase AC supply is given to the transformer which is a step-down transformer which convert 230V AC to 12V AC , 50Hz which is supplied to the bridge rectifier, It convert 12VAC to 12V DC. The output DC is the pulsating DC therefore a capacitor is connecter across the rectifier output. Then the pure 12V DC is supplied to the capacitor bank which has five capacitor each of 1microfarad are connected in parallel therefore overall output is of 5mF this capacitor bank give output during the power failure of main power supply.

The 12V DC is supplied to the IC 7805 which convert 12V DC to 5V DC the last two digits in the IC name indicates the output voltage. The voltage drop across the IC is releases in the form of heat. That 5V DC is supplied to the ARDUINO UNO R3 which is a micro controller board based on the ATmega328 (data sheet) and ATmega16U2. The 5V is supplied to the input point of the ARDUINO it is used to control the motor speed. 3, 5, 6, 9, 10, 11 these 6 pins can be used as PWM (Pulse Width Modulation) pins. Using these pins we have control the voltage in turn and speed of the motor by varying the voltage. During the working of elevator if there is an power failure due to any reason then the capacitor bank which is connected in parallel gives the power supply to the elevator to reach to its floor.

VII. CONCLUSION

In this design all the reasons for shut down of system due power cut-off are taken care and also problem associated with any type of fault, cost for maintenance and life of battery are reduced by use of capacitors.

VIII. REFERENCE

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